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A COMPARISON OF CROP TREE AND COMPETING VEGETATION RESPONSE TO BRUSHSAW RELEASE WITH VISION VERSUS SPOT TREATMENT OF VELPAR L

by

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INTRODUCTION

Tending of forest plantations to maintain survival, improve quality and increase growth is necessary for the protection of our initial stand establishment investment. Miller (1977) stresses that tending should be planned for at the time of planting or seeding and should be part of a total silvicultural package based on site conditions and related competition.

Historically in Ontario, tending operations for conifer release have been conducted using one of two methods: aerial application of herbicides or manual tending using sandviks and axes. Broadcast aerial spraying has the advantage of allowing the forest manager to release large areas of plantation quickly and at a low unit cost. In contrast, manual tending involves workers systematically felling brush and non-crop species with less than 10 cm diameter at saw height (d.s.h.) growing within close proximity to the planted or seeded crop trees. Manual tending is most often considered when the plantation is within an Area of Concern, near areas of human habitation, on a site considered environmentally sensitive or when the area requiring cleaning is small or isolated from other blocks requiring tending.

Compared to the use of herbicides, manual tending suffers from two drawbacks:it has low production rates coupled with high unit costs ($460.00 to $580.00 per hectare versus $40.00 to $135.00 per hectare for aerial release) and secondly; re-growth of cut brush and hardwood tree stems is usually rapid and profuse (Richardson 1980). The net result is that the manual tending operation must often be repeated 2 or 3 additional times prior to the conifer plantation achieving Free - to - Grow status (Lemon 1981). Although cutting the non-crop vegetation is more expensive than the application of herbicides, manual tending methods can be directed to aspen (Populus tremuloides Michx)

and other vegetation that are actually competing with crop trees. As a result the application of manual release treatments is often selective.

The introduction of motorized brush saws such as the Husqvarna 165R in the late 1970's increased the options available for manual tending. Fox and Vanderkleyn (1978) and Lemon (1981) both reported that the cost of manual tending was greatly reduced when brush saws were used in very dense stands (>10 000 stems per hectare) where average stem diameter was less than 10 cm (d.s.h.). Unfortunately hardwood re-growth following tending was often as vigorous and prolific as when the site was tended using sandviks or axes. Clearly some method of integrated chemical-mechanical control was required.

The approval of glyphosate (Roundup/Vision) and hexazinone (Velpar L) for forestry use in the mid 1980's have since provided forest managers with effective chemical tools for pre- and post-regeneration control of hardwood re-growth. Both of these chemicals are effective in controlling and reducing re-sprouting for a range of hardwood brush and tree species including birch (Betula papyrifera Marsh.), cherry (Prunus spp.), trembling aspen (Populus tremuloides Michx.), balsam poplar (Populus balsamifera L.), willow (Salix spp.), mountain maple (Acer spicatum Lam.), and raspberry (Rubus idaeus var. strigosus (Michx.) Maxim.).

Finnish-made stump treaters which are attached to the brush saw and which permit the precise application of Roundup/Vision (glyphosate) to the freshly cut stump have since brought together the mechanical and chemical control aspects of plantation release. Manual release is also possible using soil activated chemicals such as Velpar L (hexazinone). This approach involves precise spot applications of Velpar L to the soil surrounding the

crop tree or in close proximity to target shrub and tree species using a spotgun applicator.

The purpose of this study is to compare the efficacy of manual tending using brushsaws fitted with herbicide applicators for the application of glyphosate against spot gun treatments of hexazinone to release white spruce (Picea glauca (Moench) Voss) from woody shrub competition. The glyphosate product at the time of application was Roundup. The hexazinone was applied as Velpar L.

STUDY AREA

The study area is located in Ware Township, Thunder Bay District, approximately 1 km southwest of Trout Lake. The soil is a deep (>1 m), fresh and rapidly-drained silty fine sand to fine sandy loam with 10 to 35 percent coarse fragments. The 25 hectare study area was mechanically site prepared using Young's Teeth and a TTS Disc Trencher in 1978. Planting with 2+2 white spruce occurred in 1979.

METHODS

Tending was carried out from October 24 to 28, 1986 to release the white spruce from poplar (Populus tremuloides Michx.), white birch (Betula papyrifera Marsh.), beaked hazel (Corylus cornuta Marsh.), mountain maple (Acer spicatum Lam.), willow (Salix spp.), raspberry (Rubus spp.) and grasses.

Two 0.5 ha control blocks received no release treatment while two 0.5 ha blocks were treated with Brushsaws/Roundup. The remainder of the project area was released with spot gun applications of liquid hexazinone.

The glyphosate was applied at a rate of 1.3 kg ai/ha in a total mix volume of 37.8 l/ha. The hexazinone was applied at a rate of 3.0 ml/spot at a spacing of 1.8 X 1.8 m. Spots were kept at least one meter away from conifers.

Assessments plots were measured in September 1987 and 1988, respectively. A random starting point was initially chosen and systematic fixed area plots were established perpendicular to the scarification pattern. Plots were circular with a radius of 1.13 m (4 m^2).

Crop tree and vegetation measurements were made in the control and treatment areas. Total height, basal caliper, average annual height increment since release, relative dominance, and physical condition of the planted white spruce were recorded. The tree and shrub competition were described on the basis of density, average height (to the nearest 0.5 m), and physical condition. The percent cover of the forest floor by broadleaved and herbaceous vegetation was subsequently assessed for each plot.

The code descriptions used in the assessment were as follows:

Relative dominance code

D - Dominant - trees with crowns above the brush canopy level
C - Codominant - trees in the main canopy level and receiving overhead light
I - Intermediate - crowns subordinate to those in the general canopy
S - Suppressed - crowns entirely in lower layers of canopy and receiving very little light

Physical condition code

0 - Foliage healthy (green)
1 - 0 to 25% brown or defoliated
2 - 26 to 50% brown or defoliated
3 - 51 to 75% brown or defoliated
4 - 76 to 100% brown or defoliated
5 - Dead (buds and inner bark)

The data were then subjected to a One-way Analysis of Variance followed by testing using Fisher's Test of Least Significant Difference at the 5% probability level to detect significant differences between the means. The 1987 and 1988 white spruce height increments, 1987 and 1988 white spruce stem diameters and the density of competing species were analyzed in this fashion. Differences in crop tree growth between the two year's following treatment were not analyzed.

RESULTS AND DISCUSSION

(a). Growth response

White spruce growth response data are presented in Table 1. Average total heights (m) of the white spruce growing in the Brushsaw/Roundup, Velpar L/ spotgun and Control blocks were significantly different from each other one year following treatment; spruce in the Brushsaw/Roundup treatment were tallest followed by those in the Velpar L/spotgun treatment and control, respectively. After the second growing season there was no significant difference between the average total heights for spruce in the two treatment blocks. However, the average total heights for each of the two treatments were each significantly greater than that for spruce in the Control block. The increase in the average total height of spruce in the Velpar L/spotgun treatment is to be expected in the second post-spray season since the herbicidal efficacy (after Sutton 1985) of the treatment was delayed in the first post-spray growing season and extended into the second post-spray growing season.

Table 1: White spruce growth response

Treatment	No. of Plots	Density of white spruce	Average total height (m) 1987	1988	Average annual height increment (cm) 1987	1988	Average total diameter (cm) 1987	1988	Relative dominance 1987	1988	Condition code -white spruce 1987	1988
Control	20	2375	1.7 a	1.9 a	21 a	26 a	2.2 a	3.1 a	I-S	I-S	0.0	0.0
Spotgun -Velpar L	20	2381	1.5 b	2.5 b	23 a	28 a	2.6 b	4.7 b	C	C-D	1.0	1.0
Brushsaw and Roundup	20	2500	1.9 c	2.4 b	24 a	29 a	3.5 c	4.9 b	D	C	0.0	1.0

* Stocking based on 4 m^2 plots.

NOTE: Treatment response variables followed by different letters differ significantly at the p=0.001 level.

In contrast there were no significant differences in mean current annual height increments detected between the three treatments in each of the two growing seasons following spraying. This should not be surprising as numerous trials have shown that current annual height increment can be highly variable and may not be indicative of conifer response to the release treatment (after Sutton 1985) (Lehala 1988).

The average caliper (diameter breast height [D.B.H.]) of the planted spruce also differed significantly between the two treatments and the Control one year following release (Table 1). White spruce released using the Brushsaw/Roundup application had the largest D.B.H. followed by the spruce released using the Velpar L/spotgun. Spruce in the Control block had the smallest average caliper. After the second growing season there was no statistically significant difference in diameter between the spruce subjected to the two release treatments, but each remained significantly larger than that of the Control. It is important to note that, the actual felling of brush will provide immediate release, while the hexazinone treated area will not see the full effects until the second year (Anon. 1983), when herbicidal activity begins to affect competing vegetation.

Minor chlorosis and needle loss were recorded for white spruce in the area treated with hexazinone as indicated by the condition code.

(b) Herbicide Efficacy

The average number of living stems of competing woody vegetation occurring on the two treatment blocks and Control one growing season following release are displayed in Table 2.

Table 2: A comparison of the mean number of live stems of competing vegetation one year (1987) following treatment (based on $4m^2$ plots).

Treatment	Total stems	Trembling aspen	White birch	Beaked hazel	Mountain maple	Pin cherry	Willow species
Control (n=20)	26.6a	4.4a	0.2a	13.7a	5.9a	0.6a	0.4a
Spotgun - Velpar L (n=20)	21.3a	2.6a	0.3a	7.0a	9.2a	0.5a	1.1a
Brushsaw and Roundup (n=20)	23.9a	8.1b	0.4a	2.0b	8.5a	0.5a	3.3b

NOTE: Means within a species followed by different letters differ significantly at the p=0.05 level.

Initially there were no significant differences in the average total number of stems between any of the treatments. However when the species were examined individually, densities of following species were found to have varied significantly between the treatments and Control:

1. The Velpar L/spotgun treatment and control blocks had significantly fewer stems of poplar and willow than the Brushsaw/ Glyphosate treatment blocks;

2. The Brushsaw/glyphosate treatment block had significantly fewer stems of beaked hazel than both the Velpar L/spotgun and Control blocks;

Table 3: A comparison of the mean number of live stems of competing vegetation two years (1988) following treatment (based on $4m^2$ plots).

Treatment	Total stems	Trembling aspen	White birch	Beaked hazel	Mountain maple	Pin cherry	Willow species
Control (n=20)	18.8a	3.6a	0.3a	6.8a	5.6a	0.3a	1.2a
Spotgun-Velpar L (n=20)	13.8b	3.7a	0.3a	0.2b	3.8a	0.4a	2.5a
Brushsaw with Roundup (n=20)	14.2b	4.8a	0.2a	1.4c	4.3a	1.0a	4.05b

NOTE: Means within a species followed by different letters differ significantly at the p=0.001 level.

The second year assessment (Table 3) revealed a further significant reduction in the average density (all species) under both release treatments. Studies in Finland by Ruokonen (1978) and Evans (1980) both report that Roundup applied with a Brushsaw in a five percent solution was highly effective in reducing sprouts of alder and cherry. Likewise a trial conducted by Thunder Bay District, Ontario Ministry of Natural Resources, found that a complete kill of all hardwood species was possible using brushsaws with a 20 percent solution of Roundup (Bons 1984). In the later trial a 10 percent solution of RoundUp resulted in only partial kill to the hardwood component.

The delayed herbicidal efficacy of the Velpar L/spotgun treatment in controlling beaked hazel and mountain maple was also evident. The apparent reduction in the average density of beaked hazel on the Velpar L/spotgun treatment block is interesting since other studies (Day and Harvey 1980; Sutton 1986; Alm and Whorton 1988) have separately reported that hexazinone

has no control of beaked hazel.

While the number of living stems of competing species in the Brushsaw/Roundup treatment after the second season was also significantly less than that in the Control, the magnitude of the 'control' was generally less from that observed after the first season.

The significantly greater number of stems of poplar and willow one year after the Brushsaw/Roundup treatment compared to the Velpar L/spotgun and Control blocks reflected an increased amount of root suckering and stump sprouting from the cut stems.

Since the maximum efficacy for glyphosate is usually achieved in years two or three (Vanden Born 1984), the assessment of this form of mechanical/chemical release should be conducted for three to four years following treatment.

Table 4: Mean percent herbaceous ground cover one and two years following treatment (based on $4m^2$ plots).

Treatment	Percent Herbaceous cover 1987	1988
Control (n=20)	56	54
Spotgun - Velpar L (n=20)	41	41
Brushsaw and Roundup (n=20)	80	57

NOTE: Common herbs included fireweed (Epilobium angustifolium L.), strawberry (Fragaria virginiana Duchesne), long-leaved aster (Aster macrophyllus L.), pearly-everlasting (Anaphalis margaritacea L.), bunchberry (Cornus canadensis L.) and various grasses.

Mean percent cover of herbaceous vegetation on the plots within each of the treatment blocks are presented in Table 4. Herbaceous vegetation was the most abundant under the Brushsaw/Roundup treatment. This most likely reflects the complete removal of the overstory hardwood canopy which in turn resulted in rapid re-invasion of the site by grasses and herbaceous species. In contrast, the Velpar L/spotgun treatment had the lowest cover of herbaceous species. This reflects the broad spectrum efficacy of Velpar L and its ability to control germinating vegetation for an extended period following its application.

In general this operational trial was effective at illustrating the differences in efficacy which may be obtained on former mixedwood sites using the two release techniques. The reader is to be cautioned that the results are from one site only and that variation in herbicidal efficacy will be encountered with changes in site, season of application, rate of application and age of the conifer crop being released.

This trial was established using the recommended rates for Roundup/Vision (glyphosate) and Velpar L (hexazinone). However, the timing of the trial was not ideal. The label for Roundup/Vision recommends treatment no later than the first week of November if translocation of the chemical downward into the roots from the surface of the cut stump is to be ensured (Carruthers and Towill 1988) Similarly, the label for Velpar L recommends treatment from late spring until early summer.

CONCLUSIONS

1. Control using the Brushsaw/Roundup treatment resulted in minimal control of woody vegetation when applied late in the fall; further investigation of herbicidal efficacy versus season of application is required to maximize control.

2. The two release treatments within two growing seasons resulted in significant increases in stem diameter of the planted white spruce over that of the controls. The diameter increase for spruce in the Brushsaw/Roundup treatment was significantly greater than in the hexazinone treatment area one growing season following release but not after two seasons.

3. The average total number of stems per plot of competing vegetation did not differ significantly between any of the treatments one season following treatment. After two post-treatment growing seasons the average density of all species was significantly reduced with the two release treatments. No significant difference existed between the two release treatments after two growing seasons.

4. In both the first and second growing seasons following treatment, the post-spray height increment of the planted white spruce was not significantly different between any of the treatments. Average total height of the white spruce in the Brushsaw/Roundup, Velpar L/spotgun and

Control blocks were significantly different after the first and second growing seasons; released spruce were taller.

5. Since hexazinone and glyphosate are both herbicides which provide greater vegetation control two years or more after application, field staff must be prepared to monitor their local projects for two to three years for efficacy.

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